#13/APPEAL BRIEF
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042390.P5319

Patent Application

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

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In re the Patent Application of:)	
Dunton et al.)	Date: February 11, 2000
)	
Serial No.: 08/984,005)	Art Unit: 2712
Filed: December 3, 1997)	
)	Examiner: J. Wilson
For: METHOD AND APPARATUS FOR PROCESSING DIGITAL PIXEL OUTPUT SIGNALS)	

Honorable Commissioner of
Patents and Trademarks
Washington, D.C. 20231

APPEAL BRIEF
IN SUPPORT OF APPELLANTS' APPEAL
TO THE BOARD OF PATENT APPEALS AND INTERFERENCES

Sir:

Applicants (hereafter "Appellants") hereby submit this Brief in triplicate in support of their Appeal from a final decision by the Examiner in the above-captioned case. Appellants respectfully request consideration of this Appeal by the Board of Patent Appeals and Interferences for allowance of the claims in the above-captioned patent application.

An oral hearing is not desired.

I HEREBY CERTIFY THAT THIS CORRESPONDENCE IS BEING DEPOSITED WITH THE UNITED STATES POSTAL SERVICE AS FIRST CLASS MAIL IN AN ENVELOPE ADDRESSED TO:
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WASHINGTON, D.C. 20231, ON: February 16, 2000
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INTEL CORPORATION
Name of Assignee

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SIGNATURE DATE

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I. REAL PARTY IN INTEREST

The invention is assigned to Intel Corporation of 2200 Mission College Boulevard, Santa Clara, California 95052.

II. RELATED APPEALS AND INTERFERENCES

To the best of Appellants' knowledge, there are no appeals or interferences related to the present appeal that will directly affect, be directly affected by, or have a bearing on the Board's decision.

III. STATUS OF THE CLAIMS

Claims 1-24 are currently pending in the above-referenced patent application. Claims 1-24 were rejected in the Final Office Action mailed on August 18, 1999 and are the subject of this appeal. The Examiner confirmed his final rejection in an Advisory Action mailed on November 8, 1999.

The Final Office Action rejects claims 1, 9, and 17 under 35 U.S.C. §103(a) as being unpatentable over Kuribayashi (JP 2-76481 (A)) and Pain et al. (U.S. 5,886,659). The Final Office Action also rejects claims 2-8, 10-16, and 18-24 under 35 U.S.C. 103(a) as being unpatentable in view of Kuribayashi and Takase (U.S. 5,278,658).

IV. STATUS OF AMENDMENTS

To the best of Appellants' knowledge, no amendments have been filed subsequent to the Final Rejection.

A copy of all claims on appeal, claims 1-24, is attached hereto as Appendix A.

V. SUMMARY OF THE INVENTION

One technique used to improve the quality of an image generated by a digital camera calls for capturing a dark image, storing the image in memory, acquiring the image of interest, and then subtract or remove the stored dark image from the image of interest. To help minimize fixed pattern noise, it is desirable to capture the dark image under conditions that mimic the conditions used for capturing the image of interest as closely as possible. The digital camera contains circuitry that synchronizes the corresponding pixels of the dark image and the image of interest so that they may be subtracted from or compared. (page 3, line 30, through page 4, line 8)

One problem with this technique is that it introduces additional complexity because of the use of binary digital signals to perform the subtraction. For example, when employing binary digital signals of a fixed length, the dynamic range for the intensity of light received by a pixel of the imaging array is inherently limited. Therefore, when a pixel is exposed to an intensity of light that exceeds the dynamic range, the image quality is affected because the digital pixel output signal becomes saturated or clipped, and therefore, the output signal of the pixel is not an accurate representation of the intensity of the light to which the pixel was exposed. For example, a picture taken in bright sunlight. Thus, fixed pattern noise (FPN) is further acerbated when a dark image is subtracted from an image that has already been clipped because the intensity of light on some pixels exceeds the dynamic range. (page 5, lines 15-29)

An embodiment to address the problems associated with clipping and FPN is illustrated in Appellants' FIG. 3. Embodiment 300 includes a digital imaging array 310 comprising a plurality of pixels made up of sensors, such as CCD and CMOS sensors. In addition, digital camera 300 includes image processing circuitry to process the digital pixel output signals produced by the pixels of the imaging array. The raw image data is provided to a dark fixed pattern noise (DFPN) reduction or removal unit 340. In removal unit 340, the digital pixel output signals for the desired image are compared with the digital pixel output signals from the dark image from imaging array 310. (page 5, lines 1-25)

An embodiment of processing the saturated digital signals is illustrated in greater detail in FIG. 1, although Appellants' invention is not limited in scope to this particular

embodiment. As illustrated in FIG. 1, the image is first captured and then provided to saturation detect and control logic 120. If a particular digital output signal is not saturated, the captured uncorrected signal value is provided to node 130 so that the corresponding signal value of the dark image may be subtracted. However, this subtraction does not occur if the saturation detect and control logic indicates that e particular digital pixel output signal of the desired mage is saturated. The dark image is acquired and stored prior to producing and storing the desired image. In this embodiment, line buffer 150 then provides the corresponding digital pixel output signals of the dark image to be processed with the uncorrected digital pixel output signals of the desired image that was captured. Once the subtraction has occurred, the corrected digital pixel output signals are then provided to compander LUT 140. (page 6, lines 1-15)

In the embodiment illustrated in FIG. 2, a ten-digit binary value, for example "3FF" is used to indicate that the intensity of a particular pixel is saturated and has been clipped. Thus, as shown at box 240, if a pixel is saturated, the dark field value is not subtracted as the subtraction is bypassed. If the pixel is not saturated, then dark image pixel output signal is subtracted, box 260. (page 6, lines 16-34) (emphasis added)

Thus saturated digital pixel output signals are processed differently from the non-saturated pixel digital output signals. However, this different processing includes more than bypassing the subtraction of the corresponding digital pixel output signals of the dark image. For example, in one embodiment, an average dark fixed pattern noise level may be subtracted from all the saturated binary digital signal values. (page 6, lines 4-9)

VI. ISSUES PRESENTED

A. Whether claims 1, 9, and 17 are unpatentable over Kuribayashi (JP 2-76481 (A)) and Pain et al. (U.S. 5,886,659) under 35 U.S.C. §103(a), and whether claims 2-8, 10-16, and 18-24 are unpatentable in view of Kuribayashi and Takase (U.S. 5,278,658) under 35 U.S.C. 103(a.

VII. GROUPING OF CLAIMS

For the purposes of this appeal:

Claims 1, 9, and 17 stand or fall together as Group I; and

Claims 2-8, 10-16, and 18-24 stand or fall together as Group II.

Reasons for separate patentability of the above indicated Claim Groups I-II are presented in the argument section pursuant to 37 C.F.R. §1.192(c)(5).

VIII. ARGUMENT

A. REJECTION OF CLAIMS 1, 9, AND 17 (GROUP I) UNDER 35 U.S.C. § 103(a) IN VIEW OF KURIBAYASHI AND PAIN ET AL. IS IMPROPER. THE COMBINATION OF THE REFERENCES DOES NOT EXPRESSLY OR INHERENTLY MEET CLAIM LIMITATIONS DIRECTED TO "PROCESSING SATURATED DIGITAL PIXEL OUTPUT SIGNALS DIFFERENTLY FROM NON-SATURATED DIGITAL PIXEL OUTPUT SIGNALS.

The Examiner has rejected claims 1, 9, and 17 under 35 U.S.C. §103(a) as being unpatentable over Kuribayashi (JP 2-76481 (A)) and Pain et al. (U.S. 5,886,659). Appellants respectfully traverse this rejection in view of the remarks that follow.

Claim Group I

Claim 1 states:

At least one integrated circuit comprising:

image processing circuitry;

said image processing circuitry being adapted to process digital pixel output signals produced bay a digital imaging array;

said image processing circuitry being adapted to process saturated digital pixel output signals differently from non-saturated digital pixel output signals.

Appellants believe that the final rejection is based on a misunderstanding of the teachings of Kuribayashi. More importantly, the Final Office Action does not appreciate the differences between the devices disclosed by Kuribayashi and the devices that fall within the scope of Appellants' claimed invention. Accordingly, Appellants would like to begin by highlighting some of these differences.

An embodiment of Appellants' invention

Appellants would like to point out that claim 1 specifically recites that saturated digital pixel output signals are processed differently from non-saturated digital output signals (emphasis added).

Although Appellants' invention is not limited to this embodiment, an example of processing saturated and non-saturated output signals is shown in Appellants' FIG. 1 and described in Appellants' specification on pages 5, line 30, through page 6, line 15. In addition, Appellants provided a definition of saturated on page 4, lines 17-24, which states:

> "For example, when employing binary digital signals of a fixed length, the dynamic range for the intensity of light received by a pixel of the imaging array is inherently limited. Therefore, when a pixel is exposed to an intensity of light that exceeds that dynamic range, the image quality is affected because **the digital pixel output signal becomes saturated or clipped** and, therefore, the output signal of the pixel is not an accurate representation of the intensity of the light to which the pixel was exposed." (emphasis supplied)

When the output signal associated with a pixel is saturated, the signal does not provide an accurate representation of the intensity of light. This is because the output signal does not have the range desired to represent both normal images and images that come from a very bright source, such as the sun, for example. "As a result, the dynamic range of the intensity for all the image features is usually well beyond the capability of a digital sensor, leading to signal clipping." (see page 4, lines 24-26).

Summary of Kokai application

According to the Final Office Action, Kuribayashi teaches that the transmission light control part (element 15) processes saturated (bright) pixel output signals differently from non-saturated signals by adjusting the optically shielded elements according to the intensity of the light.

However, Appellants respectfully submit that the Final Office Action has incorrectly characterized the teachings of the Kokai application. More significantly, the Final Office Action has applied the language recited in Appellants' claim 1 in a manner that is inconsistent with the explicit teachings of the Kokai application.

Appellants' use of "saturated" is <u>not</u> synonymous with Kuribayashi's use of "bright"

Kuribayashi teaches that the overall quality of an optical image may be unacceptable if either back light or high intensity light is used as the reference for an image. When high or low intensity light is used as the reference to calibrate an image, the intensity of a normal image will be either too dark or too bright. In particular, the Kokai application states:

> "For example, when the portion with high luminosity is taken as the reference, the amount of light is not sufficient in the portion with low luminosity, so the entire image becomes dark. On the other hand, when the portion with low luminosity is taken as the reference, the amounts [sic] of light is excessive in the portion with high luminosity so the peripheral portion becomes blurred, and the image pickup plane may be damaged." (page 4, lines 7-14, of the translation).

Kuribayashi discloses a device that solves "... the problems of the aforementioned conventional scheme by providing a type of image pickup device which is able to form a normal video signal reliably even when light of abnormally high intensity is included." To do this, shutters (e.g., window shaped elements 14a) are adjusted in locations receiving light of abnormally high intensity so that a normal video signal can be obtained. (page 5, lines 6-8). **<u>As repeatedly stated in the description, Kuribayashi teaches the use of shutters to block out light of abnormally high intensity (i.e., bright light) so that a better image is captured.</u>**

However, Kuribayashi does not contain any teaching or suggestion of the problem discussed in Appellants' specification. In particular, Kuribayahi is devoid of any discussion related to the clipping that can occur when binary digital signals are used to represent the intensity of a pixel. As discussed above with reference to Appellants' specification, when a binary digital signal does not have sufficient dynamic range to represent a pixel, an inaccurate value results. When this occurs, the digital pixel output is considered saturated because the intensity exceeds the ability of the circuit to represent the intensity value.

Kuribayashi does not contain any teaching or suggestion of binary digital values. Moreover, Kuribayashi does not contain any teaching or suggestion of clipping or how to process saturated digital pixel output signals. **Rather, the Final Office Action conceded that Kuribayashi does not involve a digital image array**. Thus, by the Examiner's own admission, Kuribayashi does not suffer from the problem of limited dynamic range or saturation.

In addition, whether a digital pixel output signal is saturated, does not depend on how bright one pixel is relative to another. Instead, a digital pixel output signal may become saturated if the intensity of a particular pixel exceeds the dynamic range of the binary value used to represent the intensity. This determination is independent of the brightness of one pixel as compared to another. Simply stated, Kuribayashi uses "bright" or "abnormally high intensity" to indicate that the intensity of some pixels is significantly greater than the intensity of normal pixels. In contrast, Appellants' use of "saturated" refers to the inability of image processing circuitry to accurately represent the intensity of an individual pixel because the intensity of that particular pixel exceeds the dynamic range. Therefore, the Final Office Action has incorrectly asserted that the use of "bright" or "abnormally high intensity" light is synonymous with "saturated."

Accordingly, Appellants respectfully submit that the use of "bright" or "abnormally high intensity" as used by Kuribayashi refers to the intensity of some pixels as compared to the intensity of "normal" pixels. In contrast, Appellants' use of "saturated" relates to the dynamic range of an optical system and the ability of the image processing circuitry to represent a digital pixel output signal with a binary digital value having a fixed number of bits. Consequently, the assertion in the Final Office Action that "bright" is synonymous with "saturated" is not only incorrect and unsubstantiated, it is contrary to the definition of the terms as used by Kuribayashi and as used in Appellants' specification.

<u>Traversal of Rejection under 35 U.S.C. § 103</u>

THE INDEPENDENT CLAIMS INCLUDE LIMITATIONS THAT ARE NOT TAUGHT OR SUGGESTED BY THE COMBINATION OF KURIBAYASHI AND PAIN ET AL.

It is well established that obviousness requires a teaching or a suggestion by the relied upon prior art of all the elements of a claim (M.P.E.P. §2142). Without conceding the appropriateness of the combination, Appellants respectfully submit that the combination of Kuribayashi and Pain et al. does not meet the requirements of an obvious rejection in that neither teaches or suggests that saturated digital pixel output signals are processed differently from non-saturated digital pixel output signals.

As discussed above, Kuribayashi discloses a device that uses shutters to adjust the brightness of individual pixels. Moreover, the Final Office Action concedes that Kuribayashi does not involve a digital image array. Consequently, Kuribayashi does not contain any teaching or suggestion of the problems associated with digital image arrays, namely clipping. Furthermore, Kuribayashi does not contain any teaching or suggestion of how the device could be modified to address the problem of clipping. <u>**Since Kuribayashi does not contain any teaching or suggestion of clipping, it cannot contain any teaching or suggestion of the difference between saturated versus non-saturated digital pixel outputs. Therefore, Kuribayashi cannot contain any teaching or suggestion of how to process saturated digital pixel outputs differently from non-saturated digital pixel output signals.**</u>

In addition, Appellants respectfully submit that Pain et al. is also devoid of any teaching or suggestion of processing saturated digital pixel output signals differently from non-saturated digital pixel output signals. This is further evidenced by the fact that the Final Office Action does not rely on Pain et al for such a teaching in rejecting any of the dependent claims that depend from claim 1.

Since Kuribayashi and Pain et al., taken separately, are devoid of any teaching or suggestion of the limitations recited in claims 1, 9, and 17, the combination of Kuribayashi and Pain et al. must necessarily be devoid of the required teaching or suggestion of all the elements recited in claims 1, 9, and 17. Consequently, the combination cannot make Appellants' claims 1, 9, or 17 obvious.

Appellants would like to emphasize that the preceding paragraphs were not intended to attack Kuribayashi and Pain et al. separately. But instead, Appellants have shown how each is devoid of claimed elements so that, by default, the combination is also devoid of at least some of the features of Appellants' claimed invention.

B. REJECTION OF CLAIMS 2-8, 10-16, AND 18-24 (GROUP II) UNDER 35 U.S.C. § 103(a) IN VIEW OF KURIBAYASHI AND TAKASE IS IMPROPER. THE COMBINATION OF THE REFERENCES DOES NOT EXPRESSLY OR INHERENTLY MEET CLAIM LIMITATIONS DIRECTED TO "PROCESSING SATURATED DIGITAL PIXEL OUTPUT SIGNALS DIFFERENTLY FROM NON-SATURATED DIGITAL PIXEL OUTPUT SIGNALS."

The Examiner has rejected claims 2-8, 10-16, and 18-24 under 35 U.S.C. §103(a) as being unpatentable over Kuribayashi (JP 2-76481 (A)) and Takase (U.S. 5,278,658). Appellants respectfully traverse this rejection in view of the remarks that follow.

Claim 2-8, 10-16, and 18-24 depend from claims 1, 9, and 17, respectively, and thus, incorporate the elements and limitations of claims 1, 9, and 17. Therefore, Appellants' arguments made with respect to Claim Group I apply equally to Claim Group II and are incorporated by reference in this subsection of the Appeal Brief.

As discussed above, Kuribayashi does not teach processing saturated signals differently than non-saturated signals. In addition, Appellants respectfully submit that Takase does not show, teach, or suggest such processing. Instead, the apparatus disclosed in Takase "... includes a photoelectric conversion element which has a plurality of cells, the plurality of cells including shielded elements which are optically shielded so that each shielded cell outputs only the dark signal..." (see abstract)

More importantly, Takase does not teach how to process saturated signals differently than non-saturated signals. Thus, Kuribayashi and Takase, taken separately, are devoid of any teaching or suggestion of the limitations recited in claims 1, 9, and 17. Therefore, the combination of Kuribayashi and Takase must necessarily be devoid of the required teaching or suggestion of all the elements recited in claims 1, 9, and 17 and cannot make Appellants' claims 1, 9, or 17 obvious. Since claims 2-8, 10-16, and 18-24 depend from claims 1, 9, and 17, they are not obvious for at least the same reason.

IX. CONCLUSION

Appellants respectfully submit that all the pending claims in this patent application are patentable and request that the Board of Patent Appeals and Interferences overrule the Examiner and direct allowance of the rejected claims.

This brief is submitted in triplicate, along with a check for $300.00 to cover the appeal fee for one other than a small entity as specified in 37 C.F.R. § 1.17(c). Please charge any shortages and credit any overcharges to Deposit Account No. 02-2666.

Respectfully submitted,

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X. APPENDIX A: CLAIMS ON APPEAL

1. At least one integrated circuit comprising:

image processing circuitry; capable of

said image processing circuitry being adapted to process digital pixel output signals produced by a digital imaging array;

said image processing circuitry being adapted to process saturated digital pixel output signals differently from non-saturated digital pixel output signals.

2. The at least one integrated circuit of claim 1, wherein said imaging array includes imaging array sensors;

said image processing circuitry being adapted to process saturated digital pixel output signals by subtracting an estimate of the dark image fixed pattern noise for said imaging array sensors.

3. The at least one integrated circuit of claim 2, wherein said image processing circuitry is adapted to estimate the dark fixed pattern noise by sampling from a dark image comprising stored digital pixel output signals.

4. The at least one integrated circuit of claim 3, wherein said image processing circuitry is adapted to sample the dark image in regions corresponding to the regions of saturated digital pixel output signals in an image of interest.

5. The at least one integrated circuit of claim 2, wherein said image processing circuitry is adapted for use with imaging array sensors comprising at least one of a CCD sensor and a CMOS sensor.

6. The at least one integrated circuit of claim 1, wherein the image processing circuitry comprises dark fixed pattern noise reduction circuitry.

7. The at least one integrated circuit of claim 6, wherein the fixed pattern noise reduction circuitry comprises dark fixed pattern noise reduction circuitry.

8. The at least one integrated circuit of claim 1, wherein said image processing circuitry is adapted to detect regions of saturated digital pixel output signals in an image of interest.

9. A digital camera comprising:
a digital imaging array comprising a plurality of pixels, and imaging processing circuitry to process the digital pixel output signals produced by said imaging array;
said imaging processing circuitry being adapted to process saturated digital pixel output signals differently from non-saturated digital pixel output signals.

10. The digital camera of claim 9, wherein said imaging array includes imaging array sensors;
said image processing circuitry being adapted to process saturated digital pixel output signals by subtracting an estimate of the dark image fixed pattern noise for said imaging array sensors.

11. The digital camera of claim 10, wherein said image processing circuitry is adapted to estimate the dark fixed pattern noise by sampling from a dark image comprising stored digital pixel output signals.

12. The digital camera of claim 11, wherein said image processing circuitry is adapted to sample the dark image in regions corresponding to the regions of saturated digital pixel output signals in an image of interest.

13. The digital camera of claim 10, wherein said image processing circuitry is adapted for use with imaging array sensors comprising at least one of a CCD sensor and a CMOS sensor.

14. The digital camera of claim 9, wherein the image processing circuitry comprises fixed pattern noise reduction circuitry.

15. The digital camera of claim 14, wherein the fixed pattern noise reduction circuitry comprises dark fixed pattern noise reduction circuitry.

16. The digital camera of claim 9, wherein said image processing circuitry is adapted to detect regions of saturated digital pixel output signals in an image of interest.

17. A method of processing digital pixel output signals produced by a digital imaging array comprising:
processing saturated digital pixel outputs differently from non-saturated digital pixel output signals.

18. The method of claim 17, wherein said imaging array includes imaging array sensors; and further comprising estimating the dark image fixed pattern noise for said imaging array sensors;
wherein processing saturated digital pixel output signals differently includes subtracting an estimate of the dark image fixed pattern noise for said imaging array sensors.

19. The method of claim 18, wherein estimating the dark fixed pattern noise comprises sampling from a dark image comprising stored digital pixel output signals.

20. The method of claim 19, wherein sampling from a dark image comprises sampling the dark image in regions corresponding to the regions of saturated digital pixel output signals in an image of interest.

21. The method of claim 18, wherein said imaging array sensors comprise at least one of a CD sensor and a CMOS sensor.

22. The method of claim 17, wherein processing saturated digital pixel output signals comprises fixed pattern noise reduction processing.

23. The method of claim 22, wherein fixed noise reduction processing comprises dark fixed pattern noise reduction processing.

24. The method of claim 17, wherein processing saturated digital pixel output signals includes detecting regions of saturated digital pixel output signals in an image of interest.